

Glacial Lake Missoula & Other Geological Features Sanders County Montana



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Geological Notes¹:

No part of the Clark Fork / Flathead River area in Sanders County contained ice age glaciers, but glacial features are visible in Sanders County

Most of the rocks in NW Montana are thick sections of Precambrian mudstone, sandstone, & limestone known as Belt Rock

Belt Rock accumulated as deposits of mud, sand, & lime mud between 1500-800 million years ago

Belt Rock has blue-green algae fossil remains

Many Precambrian sedimentary formations consist of red & green mudstones. The red mudstones contain iron oxides, whereas the green mudstone color is from silicate minerals that contain iron in its more reduced ferrous state

1. Gigantic Ripple Current Marks

Location: Hwy 28 ~MM 31 @ Sanders County line

Ripples were formed by the torrent water currents caused from the emptying of Glacial Lake Missoula. These are the largest ripple marks in the world. Experts believe these current ripple marks were formed by water at a minimum of 800 feet deep rushing at a velocity of 55 mph.³ In this particular location there is a narrowing between the hillsides that enhances the drainage flow through this area and resulted in some of the largest ripple marks.



2. Camas Prairie Ripple Marks

Location: Hwy 382, N of Camas Prairie Rd, E&W area

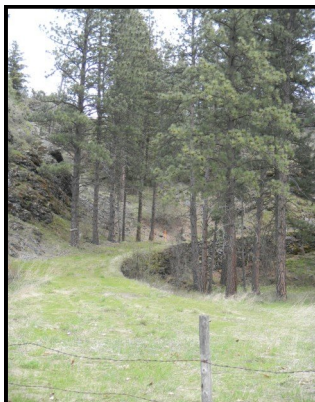
In Camas Prairie there are numerous visible long ridges of sediment that are as much as 35 feet high and about 100 feet apart. These extremely large ripple current marks were created as Glacial Lake Missoula drained.² Because this area of the Camas Prairie has never been plowed, these spectacular, world renowned giant rippled marks have been preserved.



3. CCC Road Stone Works

Location: Hwy 382 ~MM 2; E side of road

The Civilian Conservation Corps (CCC) was created by President Franklin D Roosevelt when he asked Congress to create jobs for thousands of young unemployed men. The CCC program had 300,000 young men enlist between 1933 and 1940. Evidence of their work that included reforestation projects, building & maintaining fire lookouts (such as Gem Peak, & Berry Mountain up Bull River), constructing roads and trails (shown to the right), and protecting our forests from fires, blister rust and insect infestations. In June of 1933, camps were started at Noxon, Trout Creek, and Vermillion. A fourth CCC camp was established in June of 1935 that was about 3 miles up Thompson River. Each CCC camp was a self-contained unit, essentially a viable town all by itself.⁴



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4. Ancient Shorelines

Location: Hwy 382; ~MM 1-4 various locations

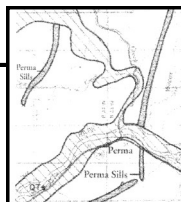
Ancient shorelines are evident by multiple horizontal shoreline benches grooved into the slopes of hillsides, visible as perfectly parallel lines. Glacial Lake Missoula had no outlet & the lake level rose until the ice Dam near Clark Fork Idaho failed & the water emptied to the Pacific Ocean. Geologists have estimated the lake emptied and filled at least 36 times. Each successive ice dam existed for less years resulting in a lower ancient horizontal shoreline as evident on the present day hillsides.^{1,2}



5. Perma Igneous Sills

Location: Hwy 200; ~MM 98, NW & SE oriented

Perma sills are a set of igneous rocks that have intruded into the PreCambrian Belt Rock. The sills are dark, fine-to-medium grained dikes & sills. A dike is a tabular intrusive igneous rock that forms when magma squeezes into vertical fractures; and a sill is magma injected into the stratified layers (that were ~horizontal when initially formed) of the host rock. The Perma Sills have a laccolith (mushroom) shape which formed when thick magma fed from below and domed up the overlying strata. The Perma sills are mafic (high in iron & magnesium). Visible from the road, the magma cooled in the form of blocky 6-sided columns.⁵



6. Sediment Valley Fill

Hwy 200; ~MM 91 road pullout; N W View,

These large deposits of sediment in the mouth of tributary valleys are known as gulch fillings or high eddy deposits. The one pictured is the most notable between Paradise and Dixon. These gulch fillings are considered to be dumps of sediment that eddied into slack water in tributary gulches as strong currents of water travelled down the main channel of the Flathead River.^{1,2}



7. Land Of Emerald Rivers

Location: Primarily the Flathead River; Hwy 200

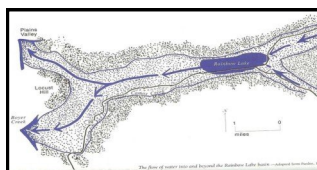
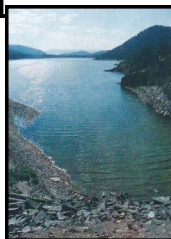
The Flathead River is a perfect example of a waterway that visually has a sea foam to emerald green color year-round. This green color is due to the presence of suspended rock flour in the water that gives off a beautiful green hue in the sunlight. Rock flour is finely ground pulverized rock that forms as rocks grind against each other within a moving glacier, and is prevalent at the surface in Camas Prairie and throughout the Flathead River bed area.



8. Rainbow (Dog) Lake

Location: Hwy 28 @ Camas Creek Road

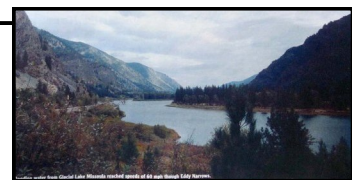
The lake is North of where Camas Prairie road dead ends on Hwy 28. Rainbow Lake is 1.5 miles long, about 1/4 mile wide, and 35 feet at its deepest point. When Glacial Lake Missoula drained, a very strong flow of water poured west out of Camas Prairie and also flowed NW up Camas Creek. The two high speed water flows met just above where Rainbow Lake now exists. This resulted in very high energy strong vertical water vortex (kolks) that swirled & plucked the Belt Rock away to form the lake basin.^{1,2}



9. Eddy Narrows

Location: Hwy 200 @ Eddy; ~ MM 65-70

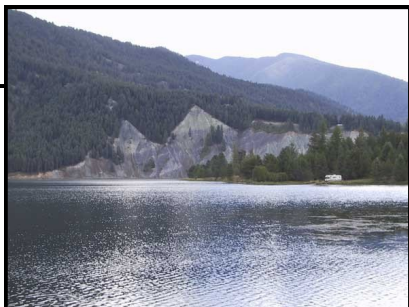
The valley walls in Eddy Narrow, which lie between Plains & Thompson Falls is nearly straight & relatively narrow for about 10 miles. Valley walls here are scoured to bare bedrock with little to no soil remaining. Whereas, the valley floor is flat & filled with fertile soil. Initial water levels during the time of drainage flow are about 1000 feet above the valley floor. J T Pardee & other geologists estimated the maximum rate of drainage flow of Glacial Lake Missoula through Eddy Narrows was at 9.46 cubic mi of water per hour. Comparatively, the maximum drainage flow on the Mississippi River was 0.05 cubic miles of water per hour.²



10. Avista Finley Flats

Location: Turn off Hwy 200 @MM42 to USFS Rd

This is a recreational use site on 50 acres owned by Avista location near and on the Clark Fork River. Findley Flats has a beautiful view of the 'blue slide' & a wide bend in the river. From the shores at Finley Flats, on the opposing river bank are exposed steep slopes of mostly unconsolidated deposited sediments that are expansive and impressive to see. It also is a wonderful place to have a picnic.



11. Avista Noxon Dam

Location: Hwy 200; ~MM 15, turn onto Dam Rd

Avista's Noxon Rapids Hydroelectric Development was completed by Avista (formerly the Washington Water Power Company) in 1959. The earth-filled dam is 260 feet high, 700 feet wide at its base, and about a mile long. Water flows from the back side of the dam through pipes into the powerhouse where it rotates turbines to create electricity. The water then flows out of the dam and into the Clark Fork River where the water continues westward. Five generators within the dam can produce 488 megawatts of electricity.⁶



REFERENCES

1. Alt, David, 2001, Glacial Lake Missoula and its Humongous Floods; Missoula, MT, Mountain Press, 199 p.
2. Alt, David & Donald W. Hyndman, 1999, Roadside Geology of Montana; Eighth Printing, Missoula, MT, Mountain Press; 427 p.
3. Read A Route; www.readaroute.com/waypoints.
4. Sanders County CCC; A legacy of firefighters, road builders, and foresters, 2004; by Fredi Pargeter & Glenn T. Garrison, Perry Publishing, 69 p.
5. The Lower Flathead River, Flathead Indian Reservation, by David Rockwell, Salish Kootenai College Tribal History Project, by Rockwell.
6. Avista Noxon Rapids Hydroelectric Development; Clark Fork River Project pedestal sign; Noxon Dam.

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